

FALLACIES IN THE LOCALIZATION OF FOREIGN BODIES BY THE X-RAY

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THE object of this paper is not to advance any new theories regarding the location of foreign bodies but rather to point out the fallacies which occur, and the need for coöperation between the surgeon and radiologist before and at the time of operation. I must apologize for my paper which has been most hurriedly prepared, owing to the extra work incident on the opening of the x-ray department at M—— Barracks Hospital.

I shall first demonstrate the methods of localization commonly employed.

The first and simplest method is that of taking two views of the part, an antero-posterior, and lateral. This gives a rough idea of the location. I found this method necessary in a large majority of the cases which were examined in France owing to the necessity for speed on the arrival of a convoy. In fact the surgeons could hardly wait until the plate was fixed, let alone dry. In order to facilitate the finding of the body I used a rule with metal points; this left the marks on the plate, and the surgeon could see how many inches above or below a joint or mark was the projectile.

The next method of localization is by stereoscope. In this the tube is moved the pupillary distance, about $2\frac{1}{2}$ inches. Two plates are taken which, when examined in a stereoscope, give the sense of distance and proportion. It is a very useful method, in fact the best in wounds of the torso. It requires an expert to interpret the stereoscope, but when done properly one is able to say that the foreign body is within the thoracic cavity or outside, and its relation to a rib or other bony structure. The method is also of use in examination of the cranium.

The third method is the Mackenzie-Davidson or some modification of it. This method is based on the constant line of travel of the x-ray from a tube which maintains its vacuum. A plate is

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used having inked cross wires at right angles to the centre of the plate. The tube is centered on the cross wires at a fixed height, 50 cm. being the usual distance, and is held in such a position that it can only move parallel to and over one of the wires. The limb to be examined is then placed on the plate and held in position. It is better to have a marker on the skin somewhere near the foreign body. The point of entrance of the *x*-ray is then marked on the skin after which one exposure is made. The tube is then moved a certain distance, 10 cm. being the best, and another exposure is made on the same plate without moving the plate or patient. In this way we secure two images of the foreign body and marker on the plate as well as the cross wires. The marks of the cross wires are left on the skin, and are made more permanent by painting over with 20 per cent. solution Argent. Nit. From the two shadows obtained we are enabled to calculate the depth of the foreign body from the plate. This is done either by calculation, logarithm scale, or by actual measurement with the apparatus which I shall show you. By this method we are able to tell exactly the position of the foreign body and were all our parts square, as cubists and futurists would have us believe, then the location of the fragment would be a very simple matter to the surgeon.

I shall now mention the fallacies, and offer a few suggestions to make the surgeon's work less arduous

Common Fallacies. The greatest difficulty which confronts the surgeon is the position of the part on which he is about to operate. Example: a patient is posed for examination with the posterior aspect against the plate, with the limb in, as nearly as possible, a true, antero-posterior position. The foreign body is near the plate. When the surgeon operates he must place the limb in the postero-anterior position which, even if exact, has necessarily caused a change in the position of the muscles. As a rule the metal is within the muscle substance and subject to movement with it. This error is particularly apparent where the metal lies in the vicinity of the shoulder girdle, where a change in the position of the arm affects the relation of all the parts.

Distortion. The *x*-rays being divergent from the focal point on the anti-cathode of the *x*-ray tube, and not parallel, distortion will naturally take place. This leads to the foreign body invariably appearing larger than normal and this is more marked the farther the metal is from the *x*-ray plate. It is also projected and never appears in its actual position unless it is directly under the principal rays of the tube. This projection may be so marked as to

throw the particle outside the limb on the plate, or, if the plate is too small, completely off the plate when there is, apparently, no foreign body present. Due allowance must always be given to this distortion when operation takes place.

Compression. As the parts are soft the weight of the part pressing on the plate makes the image appear nearer the surface than it really is.

Fallacies in the two-view method. In this method the principal difficulty is to get a true antero-posterior and lateral view, the slightest rotation of the limb will distort the picture, and give a false impression to the surgeon. I have had a box constructed which will allow of two views being taken at right angles without moving the limb. This is of especial value in those cases which cannot be removed from the stretcher.

Stereoscopic. The difficulty in actual location by this method is that actual distance from any given bony point has to be gauged by the eye of the radiologist.

Mackenzie-Davidson. The fallacies in this method are those common to all. Though the method is exact, the difficulty of operating on a round or oval body with consequent angular errors in incision is still to be reckoned with. I have here a few diagrams to show how difficult it is to keep one's incision parallel to the marking lines.

Depth. It is always to be remembered that the depth is that from the plate and not from the skin, and allowance must be made for this distance. The element of compression is most important in this method of examination as the depth given by the radiologist is that calculated while the limb is under compression. Unless the part is in the exact position in which the examination was made, or the exact reverse of that position then the error will be very great.

We now arrive at the question, how are we to overcome these errors? Errors on the part of the radiologist can only be overcome by the greatest care on the part of the expert radiologist, whose apparatus must be most exact, and carefully constructed.

Fixed positions and anatomical landmarks should be adhered to in his examination, and due note taken of them.

The radiologist should always be present at the time of operation to advise the surgeon regarding the point of incision and course to follow.

Examinations should be made shortly before operation in order that the case is fresh in the minds of both surgeon and radiologist.

The use of some apparatus in order to show the right angle lines of exposure. I have here a roughly constructed piece of apparatus which I trust to have manufactured so as to be of service.

As we are dealing with round or oval objects, and as the cranium is the most important portion of the anatomy on which we have to operate, I will detail the procedure on the part of the radiologist which I consider necessary before operation is undertaken for the removal of a foreign body. I may say that in a large number of such cases I have seen an immense amount of damage done to the brain substance without the foreign body being discovered.

The head should first be screened in order to get some idea of the location of the foreign body. An antero-posterior and lateral examination should then be made, following this a stereoscopic examination with the part nearest the foreign body next to the plate. Cross wires should be placed around the head following Reid's base line and over the head from external auditory meatus of one side to that on the other side. This gives a sense of distance proportion and location of the mass to the brain substance. After this has been done we do a Mackenzie-Davidson localization having the part nearest the foreign body (irrespective of the position in which the head had to be placed) next the plate. The point of entry of the principal ray at the first exposure should be marked in this and all cases. Thus you see I have made five plates of the head before I feel confident of the exact position. It is now up to the surgeon to find it.

I would like to mention how invaluable the needle with microphone attachment is. By its use much laceration of the part is avoided.

A MEETING of the National Executive Committee of the Patriotic Fund took place at Ottawa on December 7th, under the chairmanship of His Excellency the Governor General. It was reported on that occasion that the total contributions to the Fund up to November 30th amounted to \$16,615,778, an amount exceeding the total expenditure incurred up to that date by about three million dollars.